Yield response to P & K fertilizers over landscapes

Peter Scharf, Kent Shannon, and Vicky Hubbard
University of Missouri, Plant Sciences Division and MU Extension

Objective:
The objective of this project is to measure grain crop yield response to P and K over landscapes and identify factors that favor response. Soil tests are currently used as nearly the only tool to predict response, but we know that many other factors are involved.

Accomplishments for 2012:
● We set up five on-farm, field-scale P and K response tests with producers for 2012
  ○ All five tests were in northwest Missouri, the only quadrant of the state where we had not previously completed one of these tests.
    - Corn yield response to P was measured in 4 of the fields
    - Soybean yield response to K was measured in the fifth field.
  ○ Yields were low in all corn fields due to drought stress. Soybean yields were moderate due to late-season rains breaking the drought.
  ○ Analyses presented in this report are preliminary. Yield data were received starting 2.5 weeks before this report was due, and analyses are not yet completed.
    - Additional analyses of these tests will be completed during the winter.
    - Although 2012 is technically the last year for this project, another report will be submitted in 2013 to report on the full analyses.

● Additional funding has been obtained from the USDA-NRCS Conservation Innovation Grants program to continue this project. Seven producers have been recruited to cooperate in doing additional tests in 2013—four in northeast Missouri, two in west-central Missouri, and one in northwest Missouri.

● Locations of field-scale P and K response tests to date are shown on the map to the right.

Corn field 1 (P)
● Average corn yield response to P in this field was 0.
● Average yield in the test areas of this field was 54 bushels/acre.
  ● Drought severely limited yield in this field and in all corn fields.
  ● Low yields may have limited the potential for yield response to P.
  ● However, dry soil conditions are known to inhibit P diffusion and uptake, which could result in greater P response during dry conditions than under ideal moisture.
Yields with and without P fertilizer were compared on 12 pairs of side-by-side strips, as shown at right. In the strips receiving P, a variable-rate application was made with P rate ranging from 80 to 120 pounds of P$_2$O$_5$/acre. There were two parts of the field (central & south-central) where areas with apparent response to P were clustered. This suggests the possibility that there was a true yield response to P in these areas. We will further investigate whether this is correlated to landscape features. Yield response to P was not related to yield level in this field, although yields varied widely due to differences in water availability during the drought.

Corn field 2 (P)
- Average corn yield response to P in this field was 2 bushels/acre.
- Average yield in this field was 56 bushels/acre.
- Yields with and without P fertilizer were compared on 7 pairs of side-by-side strips.
- In the strips receiving P, a variable-rate application was made with P rate ranging from 80 to 120 pounds of P$_2$O$_5$/acre.
- There were three areas of the field with apparent clusters of positive yield response to P. This suggests the possibility that there was a true yield response to P in these areas. We will further investigate whether this is correlated to landscape features.
- Yield response to P was not related to yield level in this field.

Corn field 3 (P)
- Average corn yield response to P in this field was 0 bushels/acre.
- Average yield in this field was 67 bushels/acre.
- Yields with and without P fertilizer were compared on 3 pairs of side-by-side strips.
- In the strips receiving P, a variable-rate application was made with P rate ranging from 80 to 120 pounds of P$_2$O$_5$/acre.
- Yield response to P was not related to yield level in this field.

Corn field 4 (P)
- Average corn yield response to P in this field was 5 bushels/acre.
- Average yield in this field was 42 bushels/acre.
- Yields were compared between 1 strip without P fertilizer and yields with P fertilizer in two adjacent strips, one on either side.
- In the strips receiving P, a variable-rate application was made with P rate ranging from 20 to 110 pounds of P$_2$O$_5$/acre.
Soybean field 5 (K)

- Average soybean yield response to K in this field was 0 bushels/acre.
- Average yield in this field was 35 bushels/acre.
- Yields with and without K fertilizer were compared on 3 pairs of side-by-side strips.
- In the strips receiving K, a variable-rate application was made with K rate ranging from 40 to 60 pounds of K₂O/acre.
- In the southwest part of the field, apparent responses to P were clustered. This suggests the possibility that there was a true yield response to P in these areas. We will further investigate whether this is correlated to landscape features.

SUMMARY

- Yield response to P and K in five fields in northwest Missouri in 2012 was minimal, with field-average response ranging from 0 to 5 bushels per acre.
- Low yield level resulting from drought, especially for the corn, may have contributed to low P and K responses.
- Little evidence was seen that yield response to P or K was greater in higher-yielding parts of the field.
- Additional analyses of spatial patterns of yield response will be conducted to see how soil test levels and landscape variables were related to yield response.

Conclusions from previous years:

- Yield response to P and K was concentrated in one or two soils in each field that we have analyzed.
- There is a tendency for the most responsive soil to also be:
  - The highest yielding soil
  - The best-drained soil
- Soil test values had no relationship to yield response to P and K in 2 of the 3 fields that we have completed our analyses on.
- In the third field, soil test values for both P and K were low, and yield responses were seen in areas with soil test P below 5 ppm or soil test K below 80 ppm. No yield response was seen in this field with soil test P of 5 ppm or greater, or soil test K of 80 ppm or greater.
- Strip trials to measure yield response to P and K are a practical and fairly simple way for producers to better understand how to optimize P and K management on their own farm.